Dirasat: Human and Social Sciences, Volume 53, No. 6, 2026, 8619

Deanship of Scientific Research

An Empirical Study on the Cultivation of Critical Thinking in High School Academic English Writing

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Received: 2/8/2024
Revised: 15/11/2024
Accepted: 18/12/2024
Published online: 1/1/2026

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Citation: Tian, W., Nasri, N. M., & Bin Jamaludin, K. . A. (2026). An Empirical Study on the Cultivation of Critical Thinking in High School Academic English Writing. *Dirasat: Human and Social Sciences*, *53*(6), 8619.
https://doi.org/10.35516/Hum.2026.8619

Abstract

Objectives: This study aims to explore the application and cultivation effects of critical thinking in high school academic English writing, with a particular focus on identifying effective teaching strategies and intervention methods.

Methods:. A mixed-methods approach was employed, involving 120 second-year high school students (aged 15-16) in Shaanxi Province, China. The study included: (1) a 10-week teaching intervention with experimental (n=60) and control (n=60) groups; (2) pre- and post-intervention CCTDI-CV questionnaires; (3) writing assessments based on IELTS Task 2 criteria; and (4) semi-structured interviews with 10 randomly selected participants (20-30 minutes each).

Results:. The study revealed significant improvements in students' critical thinking disposition, particularly in truth-seeking, open-mindedness, and analytical ability. The experimental group also demonstrated marked progress in academic writing skills, especially in analytical thinking and argumentative expression. Qualitative data further indicated enhanced metacognitive awareness and strategic application of critical thinking in writing processes.

Conclusions: The findings suggest that critical thinking plays an important role in high school academic English writing. Based on these results, the study proposes corresponding teaching recommendations and directions for future research, emphasizing the need for integrated critical thinking instruction in English writing curriculum.

Keywords: Critical thinking; high school academic English writing; academic writing

دراسة تجريبية حول تنمية التفكير النقدي في كتابة اللغة الإنجليزية الأكاديمية في المدرسة الثانوية

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ملخّص

الأهداف: تهدف هذه الدراسة إلى استكشاف تطبيق وآثار تنمية التفكير النقدي في كتابة اللغة الإنجليزية الأكاديمية في المدارس الثانوية، مع التركيز بشكل خاص على تحديد استراتيجيات التدريس الفعالة وطرق التدخل.

المنهجية: تم استخدام منهج مختلط، شمل 120 طالباً في السنة الثانية من المرحلة الثانوية (15-16 سنة) في مقاطعة شنشي، الصين. تضمنت الدراسة: (1) تدخل تعليمي لمدة 10 أسابيع مع مجموعة تجريبية (ن=60) ومجموعة ضابطة (ن=60)؛ (2) استبيانات CCTDI-CV قبل وبعد التدخل؛ (3) تقييمات الكتابة بناءً على معايير IELTS Task 2 ؛ و(4) مقابلات شبه منظمة مع 10 مشاركين تم اختيارهم عشوائياً (20-30 دقيقة لكل منهم)

النتائج: كشفت الدراسة عن تحسينات كبيرة في توجه الطلاب نحو التفكير النقدي، خاصة في البحث عن الحقيقة، والانفتاح الذهني، والقدرة التحليلية. كما أظهرت المجموعة التجريبية تقدماً ملحوظاً في مهارات الكتابة الأكاديمية، وخاصة في التفكير التحليلي والتعبير الحجاجي. وأشارت البيانات النوعية أيضاً إلى تعزيز الوعي ما وراء المعرفي والتطبيق الاستراتيجي للتفكير النقدي في عمليات الكتابة.

الخلاصة: تشير النتائج إلى أن التفكير النقدي يلعب دوراً مهماً في كتابة اللغة الإنجليزية الأكاديمية في المدارس الثانوية. واستناداً إلى هذه النتائج، تقترح الدراسة توصيات تعليمية واتجاهات للبحث المستقبلي، مع التأكيد على الحاجة إلى دمج تعليم التفكير النقدي في منهج الكتابة باللغة الإنجليزية.

الكلمات الدالة:التفكير النقدي؛ الكتابة الأكاديمية باللغة الإنجليزية في المدارس الثانوية؛ الكتابة الأكاديمية

Introduction

The China Advanced Placement (CAP) program, launched as a national educational initiative in 2020, aims to provide high school students with university-level course experiences to help them adapt to university learning modes and requirements in advance (Ministry of Education of the People's Republic of China, 2020). As one of the initial courses offered under CAP, English academic writing provides a valuable practical foundation for promoting academic English writing at the high school level and creates opportunities for students to develop critical thinking and advanced writing skills.

Paul and Elder (2021, p. xxii) define critical thinking as "the art of thinking about thinking in order to improve thinking." This definition emphasizes the reflective and improvement-oriented nature of critical thinking. Meanwhile, Hyland (2004, p. 149) points out that academic writing is a socially constructed process through which the writer not only conveys information but also establishes their academic identity and relationship with the reader. There is an inherent connection between these two concepts: critical thinking provides the analytical framework and argumentative basis for academic writing, while academic writing serves as the vehicle for the expression and development of critical thinking (Paige, Rupley, & Ziglari, 2024; Ku & Ho, 2010).

Based on the implementation of the CAP curriculum, this study addresses the following research question:

What are the effects of integrating critical thinking into academic English writing for high school students in the CAP program?

Through this question, the present study explores the application mechanism of the critical thinking model in high school academic English writing instruction and its impact on enhancing students' critical thinking abilities. Through a combination of qualitative and quantitative empirical research methods, the study aims to analyze in depth both the measurable outcomes of the instructional intervention and students' experiences in applying critical thinking to their academic writing process. The research findings are hoped to provide theoretical basis and practical guidance for teaching practices in other key high schools, thereby systematically enhancing students' critical thinking abilities and academic writing skills and laying a solid cognitive and skill foundation for their future higher education and career development.

Literature Review

Definition of Critical Thinking

Although there is some debate in academia regarding the definition of critical thinking, consensus has been reached on its core elements. Ennis (2011) views critical thinking as a process of reasonable reflective thinking, while Davies (2015, p. 62) emphasize its nature as a form of metacognition that aims to improve thinking. Facione (1990), through the Delphi method, proposed a more comprehensive definition that includes cognitive skills such as interpretation, analysis, evaluation, and inference. Brookfield (2012) particularly highlights the importance of questioning assumptions and exploring alternatives. Integrating these perspectives, critical thinking can be understood as a goal-oriented, reflective thinking process that involves various cognitive skills and dispositions aimed at making reasonable judgments and improving the quality of thinking. In the context of high school academic English writing, it is manifested in students' ability to analyze problems, evaluate explaination, construct arguments (Fisher, 2001, p. 8), and reflect on their thinking process. This not only enhances the quality of writing but also fosters lifelong learning skills (Cottrell, 2017, p. 4) and academic literacy (Hyland, 2004, p. 146).

Models of Critical Thinking

Throughout the evolution of critical thinking theories, various models have emerged, each with unique features. The Paul-Elder Model (2001, p. 5) emphasizes the systematic nature and evaluation of the thinking process; the revised Bloom's Taxonomy (Anderson et al., 2001, p. 28), although not exclusively focused on critical thinking, offers valuable insights into higher-order cognitive skills; Ennis's Model (2011) focuses on the interaction between cognitive abilities and affective dispositions. Among these theoretical frameworks, Facione's (1990) model of core critical thinking skills stands out for its

comprehensiveness and practicality. Developed through the Delphi method to distill expert consensus, this model elucidates six core cognitive skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. This theoretical framework (Davies, 2015, p. 85) not only aligns well with the cognitive processes involved in academic writing but also provides clear operational definitions for teaching practice. Importantly, Facione's model emphasizes the holistic nature of critical thinking, balancing cognitive skills and dispositions, which resonates with the complexity of academic writing.

In the context of the China Advanced Placement (CAP) program, this model provides theoretical support for designing progressive learning tasks and assessing the development of critical thinking. However, translating this theoretical model into practical teaching for high school academic English writing poses several challenges: Aadjusting skill requirements according to students' cognitive development stages and effectively cultivating these higher-order thinking skills within the constraints of limited teaching resources are issues that warrant in-depth exploration. These challenges form the core issues of this study, aiming to offer new insights into bridging theory and practice through empirical research.

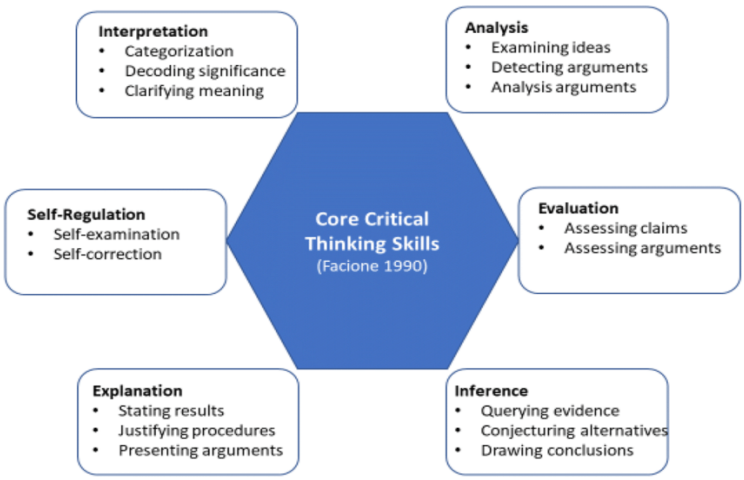

Figure 1. The Model of Core Critical Thinking Skills (Facione, 1990)

Framework for the Application of Critical Thinking in High School Academic English Writing

This study integrates Facione's (1990) model of core critical thinking skills and White & Arndt's (1991, p.17) process writing model to construct a framework for applying critical thinking in high school academic English writing. The White & Arndt model emphasizes the recursive nature of writing, including stages such as idea generation, focusing, structuring, evaluating, reviewing, and editing, which align closely with the characteristics of academic writing. Its flexibility facilitates the integration of critical thinking skills.

The framework systematically incorporates Facione's critical thinking skills (interpretation, analysis, evaluation, inference, explanation, and self-regulation) into the entire academic writing process. From topic selection to final revision, each stage of writing corresponds to specific critical thinking skills, aiming to cultivate students' conscious use of higher-order thinking abilities in their writing.

The design of the framework considers the cognitive development characteristics of high school students and highlights the importance of critical thinking at various stages of academic writing. It covers stages such as topic exploration, data research, argument construction, argument development, and communication reconstruction, each requiring the use of different critical thinking skills. This not only enhances writing skills but also fosters critical thinking literacy. Additionally, the framework reflects the cyclical and iterative nature of the writing process, particularly in the communication reconstruction stage, encouraging students to engage in self-reflection and revision based on feedback. This design aligns with modern writing theory's emphasis on the recursive nature of writing, providing students with opportunities to apply higher-order critical thinking skills such as self-regulation.

Overall, this framework offers new perspectives and methods for teaching high school academic English writing by

organically integrating critical thinking cultivation into the writing process. It provides students with a clear learning pathway and teachers with effective teaching and assessment tools, with the potential to enhance students' academic writing skills while fostering their critical thinking literacy.

Table 1. Framework for the Application of Critical Thinking in High School Academic English Writing

Writing Stage	Content Description	Critical Thinking Skills
Topic Exploration	Determine writing directions, analyze topic requirements, form initial writing ideas	Interpretation (understanding the topic), Analysis (identifying key concepts), Evaluation (judging feasibility of the topic)
Data Research	Collect relevant information, evaluate the reliability of sources, synthesize different viewpoints	Analysis (filtering information), Evaluation (judging the quality of sources), Inference (connecting different pieces of information)
Argument Construction	Form core arguments, design the structure of the argument, anticipate counterarguments	Inference (forming arguments), Analysis (constructing the argument framework), Evaluation (considering different perspectives)
Argument Development	Elaborate on arguments, provide supporting evidence, develop a complete essay	Explanation (clearly expressing ideas), Inference (logical reasoning), Analysis (organizing essay structure)
Communication and Reconstruction	Seek feedback, evaluate suggestions, revise and improve the essay, deepen understanding	Evaluation (assessing feedback), Self-Regulation (revising viewpoints), Explanation (clarifying ideas), Analysis (integrating new insights)

Research Design

This study employs a mixed-methods approach, combining quantitative and qualitative analysis paradigms, to systematically explore the application and cultivation effects of critical thinking in high school academic English writing. The subjects are 120 second-year high school students (aged 15-16) from a key high school participating in the China Advanced Placement (CAP) program. Using stratified random sampling, the participants are equally divided into experimental and control groups, with 60 students in each group, to control for external variables that might influence the research outcomes.

The data collection methods are diversified, including questionnaires, writing task assessments, and semi-structured interviews. First, the internationally recognized California Critical Thinking Disposition Inventory-Chinese Version (CCTDI-CV) questionnaire, comprising 70 items covering seven dimensions (truth-seeking, open-mindedness, analytical ability, systematic thinking, critical confidence, inquisitiveness, and cognitive maturity), is administered before and after the teaching intervention to both groups. Second, after the intervention, a 45-minute timed writing task is organized, requiring participants to complete a 200-word essay like the IELTS Writing Task 2. The assessment criteria, based on Facione's critical thinking model and academic writing standards, cover five dimensions with a total score of 9 points. Finally, 10 students from the experimental group are randomly selected for in-depth interviews, each lasting 20-30 minutes, to gain a deeper understanding of the strategies and challenges students face in applying critical thinking to academic writing.

The research procedure strictly follows experimental design principles, including pre-test, experimental treatment, post-test, and interviews. The experimental group undergoes a 10-week intervention, with two sessions per week, integrating critical thinking into academic English writing instruction; the control group receives traditional academic English writing instruction to ensure effective control of research variables.

Data analysis employs multivariate statistical methods. SPSS software is used for descriptive and inferential statistical analysis of the CCTDI-CV questionnaire data, including independent samples t-tests and repeated measures ANOVA, to examine the impact of the experimental treatment on critical thinking disposition. The writing samples are scored using a double-blind scoring method to ensure objectivity and reliability. Independent samples t-tests are conducted to compare the writing performance of the two groups, along with correlational analysis to explore the relationship between critical thinking disposition and writing performance. Qualitative data are analyzed using thematic analysis, extracting key themes through open coding and axial coding. Finally, triangulation is used to integrate quantitative and qualitative data, enhancing the validity and credibility of the research conclusions.

Table 2. Academic Writing Assessment Criterion

Score	Understanding and Analysis	Evaluation and Inference	Innovation and Critique	Expression and Argumentation	Academic Writing Standards
9	Deep and accurate understanding of the topic requirements, comprehensive identification of key elements, precise discernment of information relevance and importance.	Systematic evaluation of argument credibility, keen identification of biases and assumptions, drawing reasonable conclusions based on sufficient evidence, deeply predicting potential consequences.	In-depth comparison of multiple viewpoints, proposing innovative and feasible alternatives, profound reflection on the thinking process, effectively correcting errors or limitations.	Core argument articulated extremely clearly, using rich and appropriate examples, with logically organized information.	Complete structure, rigorous logic; professional and accurate use of academic language; citations and references fully comply with standards.
8	Accurate understanding of the topic requirements, identification of most key elements, good discernment of information relevance and importance.	Effective evaluation of argument credibility, identification of major biases and assumptions, drawing conclusions based on strong evidence, predicting major consequences.	Comprehensive comparison of different viewpoints, proposing feasible alternatives, serious reflection on the thinking process, correcting major errors or limitations.	Core argument articulated clearly, using appropriate examples, with strong logical organization of information.	Complete structure, clear logic; appropriate use of academic language; citations and references generally comply with standards.
7	Good understanding of the topic requirements, identification of most key elements, fair discernment of information relevance and importance.	Evaluation of most argument credibility, identification of some biases and assumptions, drawing basic reasonable conclusions based on evidence, predicting some consequences.	Comparison of main viewpoints, proposing some feasible solutions, demonstrating some self-reflection, attempting to correct errors or limitations.	Core argument articulated clearly, using some appropriate examples, with some logical organization of information.	Basic structure is complete, with good logic; appropriate use of academic language; citations and references generally comply with standards.
6	Basic understanding of the topic requirements, identification of some key elements, ability to discern some information relevance and importance.	Evaluation of some arguments, identification of some obvious biases or assumptions, attempting to draw conclusions based on evidence, predicting some possible consequences.	Attempting to compare different viewpoints, proposing basic feasible solutions, showing some self-reflection, recognizing some errors or limitations.	Core argument expressed clearly, using some examples, with some logical organization but lacking coherence.	Basic structure is complete, with average logic; partial use of academic language; citations and references show some compliance but lack rigor.

Score	Understanding and Analysis	Evaluation and Inference	Innovation and Critique	Expression and Argumentation	Academic Writing Standards
5	Partial understanding of the topic requirements, identification of few key elements, limited discernment of information relevance and importance.	Evaluation of few arguments, identification of very few biases or assumptions, weak association of conclusions with evidence, rarely predicting consequences.	Rarely comparing different viewpoints, proposing solutions with limited feasibility, insufficient self-reflection, struggling to recognize major errors or limitations.	Core argument expressed unclearly, with insufficient or inappropriate examples, weak logical organization of information.	Structure is incomplete, with poor logic; inadequate use of academic language; citations and references have significant issues.
4	Misunderstanding of the topic requirements, difficulty in identifying key elements, almost unable to discern information relevance and importance.	Rarely evaluates arguments, difficulty in identifying biases or assumptions, poor association of conclusions with evidence, almost never predicting consequences.	Rarely compares different viewpoints, difficulty in proposing feasible solutions, almost no self-reflection, unable to recognize major errors or limitations.	Core argument vague, lacking appropriate examples, disorganized information presentation.	Incomplete structure, confused logic; very little use of academic language; citations and references often non-compliant.
3	Severe misunderstanding of the topic requirements, unable to identify key elements, cannot discern information relevance and importance.	Unable to evaluate arguments, failing to identify any biases or assumptions, conclusions unrelated to evidence, no predictions made.	Does not compare different viewpoints, cannot propose any solutions, no self-reflection, completely unable to recognize errors or limitations.	Core argument unclear, no examples used, information presentation lacks logic.	Structure chaotic, logic severely lacking; does not use academic language; citations and references completely non-compliant.
2	Severe misunderstanding of the topic requirements, able to identify very few insignificant elements, completely unable to discern information relevance.	Almost unable to evaluate arguments, occasionally mentioning some irrelevant biases or assumptions, conclusions wholly unrelated to the topic.	Only mentions one viewpoint, cannot propose any meaningful solutions, no signs of self-reflection.	Core argument extremely vague, examples (if any) unrelated to the argument, information presentation chaotic.	Almost no structure, confused logic; extremely colloquial language; citations and references (if any) completely non-compliant.
1	Completely misunderstanding of the topic requirements, unable to identify any relevant elements, fully unaware of the concept of information relevance.	No attempt to evaluate arguments, misunderstanding the concept of biases or assumptions, conclusions (if any) completely unreasonable.	Does not mention any viewpoints, does not understand the concept of "solutions," completely lacks self-reflective awareness.	No identifiable core argument, no examples used, information presentation entirely random.	No structure whatsoever, logic completely absent; extremely improper language use; no concept of citations or references.
0	Task not completed or completely off-topic.				

Results and Discussion

To investigate the effects of integrating critical thinking into academic English writing, this study analyzed both quantitative and qualitative data. The quantitative analysis examined the intervention effects through CCTDI-CV questionnaire results and academic writing test scores, while the qualitative analysis explored students' experiences and development through interview data. Together, these analyses provide comprehensive insights into how critical thinking affects students' academic writing performance and thinking development in the CAP program.

Quantitative Data Analysis

Analysis of Questionnaire Results

This study utilized the California Critical Thinking Disposition Inventory Chinese Version (CCTDI-CV) to assess both the experimental and control groups before and after the teaching intervention. The results indicated that the experimental group showed significantly greater improvement in both the total CCTDI-CV score and all seven dimensions compared to the control group, providing robust evidence for the effectiveness of integrating critical thinking into academic English writing instruction.

In terms of total scores, the experimental group increased from a pre-test score of 60.5 to a post-test score of 75.3, averaging an improvement of 14.8 points. In contrast, the control group only increased from 61.0 to 65.5, with an average improvement of 4.5 points. The difference between the two groups was statistically significant ($F = 15.32$, $p < 0.001$), indicating that critical thinking instruction has a marked effect on enhancing students' overall critical thinking disposition.

Specifically, the experimental group exhibited the most significant improvements in the dimensions of truth-seeking, open-mindedness, and analytical thinking, with increases of 3.5, 3.4, and 3.3 points, respectively. This result reflects that the teaching methods employed in this study particularly foster students' investigative spirit, open attitudes, and analytical skills. Additionally, the experimental group also showed considerable improvement in systems thinking and cognitive maturity (2.6 and 2.5 points, respectively), suggesting that the instructional approach helps cultivate comprehensive thinking abilities and mature cognitive attitudes among students. The enhancements in critical self-confidence and curiosity (2.4 and 2.2 points, respectively) further indicate an increase in students' self-confidence and motivation during the learning process.

In contrast, the control group demonstrated relatively minor improvements across all dimensions, with the largest increase being only 1.1 points in the truth-seeking dimension. This comparison further underscores the effectiveness of the critical thinking instructional intervention. All dimension differences were statistically significant ($p < 0.01$), strongly supporting the validity of integrating critical thinking into academic English writing instruction.

Table 3. Comparison of Pre-Test and Post-Test Results for the Experimental and Control Groups Across Dimensions of Critical Thinking

Dimensions	Groups	Pre-test M (SD)	Posttest M (SD)	ΔM	F	p
Total Score	Experiment	60.5 (8.2)	75.3 (7.5)	14.8	15.32	0.001
	Control	61.0 (8.1)	65.5 (7.8)	4.5		
Truth-Seeking	Experiment	12.3 (2.1)	15.8 (2.0)	3.5	12.45	0.003
	Control	12.4 (2.2)	13.5 (2.1)	1.1		
Open-mindedness	Experiment	14.2 (2.5)	17.6 (2.3)	3.4	13.78	0.002
	Control	14.3 (2.4)	15.1 (2.5)	0.8		
Analytical Ability	Experiment	10.8 (1.8)	14.1 (1.7)	3.3	14.21	0.002
	Control	10.9 (1.9)	11.6 (1.8)	0.7		
Systems Thinking	Experiment	8.7 (1.4)	11.3 (1.3)	2.6	11.96	0.003
	Control	8.8 (1.5)	9.4 (1.4)	0.6		
Critical Self-confidence	Experiment	6.5 (1.1)	8.9 (1.0)	2.4	13.45	0.002
	Control	6.6 (1.2)	7.1 (1.1)	0.5		
Curiosity	Experiment	5.6 (0.9)	7.8 (0.8)	2.2	12.79	0.003
	Control	5.7 (1.0)	6.1 (0.9)	0.4		
Cognitive Maturity	Experiment	7.4 (1.3)	9.9 (1.2)	2.5	14.89	0.001
	Control	7.5 (1.4)	8.1 (1.3)	0.6		

The more significant improvements in truth-seeking (3.5 points), open-mindedness (3.4 points), and analytical thinking (3.3 points) can be attributed to several factors.

The nature of academic writing tasks inherently demands students to seek reliable evidence and evaluate multiple perspectives, which directly cultivates their truth-seeking disposition. For instance, when writing argumentative essays, students must search for and verify information from various sources, naturally developing their ability to pursue truth and evidence.

The significant improvement in open-mindedness reflects the effectiveness of the teaching intervention's emphasis on considering multiple viewpoints. The writing tasks required students to acknowledge and respond to counter-arguments, encouraging them to examine issues from different angles. This practice of considering opposing views and alternative explanations helped foster a more open-minded approach to academic discourse.

The notable enhancement in analytical thinking aligns with the core requirements of academic writing. The process of breaking down complex topics, evaluating evidence, and constructing logical arguments directly strengthens students' analytical capabilities. The systematic approach to academic writing, from outline planning to argument construction, provides continuous opportunities for developing analytical skills.

Analysis of Academic Writing Test Results

A comparison of the performance of the experimental and control groups in the academic writing test clearly demonstrates significant progress in all dimensions for the experimental group. After the academic writing instruction, the experimental group's total score increased from a pre-test score of 5.2 to a post-test score of 8.5, resulting in a change of +3.3 points. In contrast, the control group's total score only increased from 5.3 to 6.0, with a change of just +0.7 points. The difference between the experimental and control groups was statistically significant ($F = 35.4$, $p < 0.001$). Breaking it down by scoring dimension:

Understanding and Analysis: The experimental group's average score improved from 5.1 in the pre-test to 8.4 in the post-test, with a change of +3.3 points ($F = 30.5$, $p < 0.001$). The control group showed a smaller increase, rising from 5.2 to 6.1, with a change of +0.9 points.

Evaluation and Reasoning: The experimental group increased from 5.3 to 8.6, showing a change of +3.3 points ($F = 33.2$, $p < 0.001$). The control group's score improved from 5.4 to 6.2, with a change of +0.8 points.

Innovation and Critique: The experimental group's score rose from 5.0 to 8.3, reflecting a change of +3.3 points ($F = 31.7$, $p < 0.001$), while the control group moved from 5.1 to 6.0, with a change of +0.9 points.

Expression and Argumentation: The experimental group's score increased from 5.4 to 8.7, a change of +3.3 points ($F = 34.6$, $p < 0.001$). The control group's score went from 5.5 to 6.3, a change of +0.8 points.

Academic Writing Norms: The experimental group's score rose from 5.2 to 8.5, with a change of +3.3 points ($F = 32.8$, $p < 0.001$). In contrast, the control group's score improved from 5.3 to 6.1, with a change of +0.8 points.

Overall, the significant progress made by the experimental group across all scoring dimensions indicates that academic English writing instruction effectively enhances high school students' critical thinking abilities and academic writing skills. The limited progress observed in the control group further validates the effectiveness of integrating critical thinking into academic English writing instruction.

Table 4. Comparison of Academic Writing Scores Between Experimental and Control Groups

Dimensions	Group	Pre-test Mean (M) (M) ± Standard Deviation (SD)	Post-test Mean (M) ± Standard Deviation (SD)	Change (ΔM)	F-value	p-value
Total Score	Experiment	5.2 ± 1.1	8.5 ± 0.9	+3.3	35.4	<0.001
	Control	5.3 ± 1.2	6.0 ± 1.1	+0.7		
Understanding and	Experiment	5.1 ± 1.0	8.4 ± 0.8	+3.3	30.5	<0.001

Dimensions	Group	Pre-test Mean (M) (M) ± Standard Deviation (SD)	Post-test Mean (M) ± Standard Deviation (SD)	Change (ΔM)	F-value	p-value
Analysis	Control	5.2 ± 1.1	6.1 ± 1.0	+0.9		
Evaluation and Reasoning	Experiment	5.3 ± 1.1	8.6 ± 0.9	+3.3	33.2	<0.001
	Control	5.4 ± 1.0	6.2 ± 1.1	+0.8		
Innovation and Critique	Experiment	5.0 ± 1.2	8.3 ± 0.8	+3.3	31.7	<0.001
	Control	5.1 ± 1.1	6.0 ± 1.2	+0.9		
Expression and Argumentation	Experiment	5.4 ± 1.0	8.7 ± 0.9	+3.3	34.6	<0.001
	Control	5.5 ± 1.1	6.3 ± 1.0	+0.8		
Academic Writing Standards	Experiment	5.2 ± 1.1	8.5 ± 0.8	+3.3	32.8	<0.001
	Control	5.3 ± 1.0	6.1 ± 1.1	+0.8		

Qualitative Data Analysis

This study employed thematic analysis (Braun & Clarke, 2006) to analyze the semi-structured interview data. Two researchers conducted coding independently and then reached a consensus through discussion to enhance the reliability of the analysis. The coding process followed the steps of open coding, axial coding, and selective coding until theoretical saturation was achieved. Ultimately, three main themes and nine sub-themes were identified, as shown in Table 5.

Table 5. Overview of Themes in Qualitative Data Analysis

Themes	Sub-themes
Application of Critical Thinking in Academic Writing	In-depth Understanding and Analysis
	Evaluation and Reasoning Skills
	Innovation and Critique Skills
Challenges and Strategies in Academic Writing	Difficulty in Information Selection
	Unclear Argument Structure
	Inaccurate Language Expression
Overall Improvement of Critical Thinking Skills	Raising Questions and Doubts
	Identifying Biases and Assumptions
	Critical Evaluation and Reflection

Application of Critical Thinking in the Academic Writing Process

1. In-depth Understanding and Analysis

Students generally reported that critical thinking significantly enhanced their understanding and analytical abilities regarding writing prompts. One student (S1) described her experience:

"Before, I would just read the prompt simply. Now I think deeply about every aspect of the topic. For example, when I see the prompt 'Discuss the impact of social media on interpersonal relationships,' I consider: What is social media? What platforms does it include? What types of interpersonal relationships are there? This multi-faceted thinking makes my essay more comprehensive. My analytical scores improved from basic understanding (level 5) to comprehensive analysis (level 8) after adopting this approach."

Another student (S2) added,

"Critical thinking taught me how to break down complex problems. Now, when faced with a difficult issue, I no longer

feel at a loss but can analyze step by step to find the key points. This systematic analysis has particularly helped me in developing more thorough thesis statements and topic sentences."

2. Evaluation and Reasoning Skills

During the information selection and argument construction processes, students' evaluation and reasoning skills showed significant improvement. Student (S3) shared her experience:

*"I used to accept all information without questioning it. Now I question the sources and reliability of the information. For example, when writing an article about climate change, I not only consulted government reports but also compared different scientists' viewpoints. *This critical evaluation process has helped me develop stronger arguments - my recent essays now include at least three different perspectives supported by credible sources, compared to my previous tendency to rely on a single viewpoint."*

3. Innovation and Critique Skills

Students demonstrated stronger innovation and critique skills in academic writing. One student (S4) described his transformation:

"Critical thinking makes me no longer satisfied with simply repeating others' viewpoints. During the writing process, I actively think: What are the limitations of this argument? Are there any other possible explanations? This approach has significantly improved my ability to develop original arguments--in my recent essays, I've been able to propose new solutions by synthesizing different perspectives, rather than just summarizing existing views. This way of thinking adds depth to my essay and makes it more persuasive."

These findings align closely with Facione's (1990) core skills model of critical thinking. For instance, the progress students made in "in-depth understanding and analysis" reflects the "interpretation" and "analysis" skills in Facione's model, while the enhancement of "evaluation and reasoning skills" corresponds to the "evaluation" and "reasoning" skills in the model. The students' responses particularly highlight improvements in three key areas: analytical depth (from surface-level reading to multi-dimensional analysis), evaluation rigor (from passive acceptance to active questioning), and innovative thinking (from summarizing to synthesizing).

Main Challenges in Academic Writing and Coping Strategies

1. Difficulties in Information Selection

Many students reported that, faced with a vast amount of information, determining which materials are most relevant and valuable poses a significant challenge. Student (S5) shared her coping strategy:

"I learned to use the CRAAP test (Currency, Relevance, Authority, Accuracy, Purpose) to evaluate materials. Initially, I spent nearly two hours evaluating sources for each essay, but after two months of practice, I can now complete this process in about 30 minutes. For example, in my recent essay about artificial intelligence, I was able to quickly identify three credible academic sources and two reliable industry reports, while before I would have just used the first few Google results. This method helps me quickly assess the timeliness, relevance, authority, accuracy, and purpose of the information. Although it felt slow when I first started using this method, it has now become a habit that greatly improves my efficiency in selecting materials."

2. Unclear Argument Structure

Constructing a clear argument structure is another common challenge. Student (S6) described his solution:

"I now start by creating a mind map to clarify the relationships between various arguments. This has transformed my writing structure dramatically. In my previous essays, my arguments often seemed disconnected, scoring around 5-6 points in organization. Now, using the mind mapping technique, my recent essays have consistently scored 8-9 points in structural

coherence. Then, I organize each paragraph using the structure of 'topic sentence - evidence - example - conclusion.' For instance, in my essay about environmental protection, I was able to clearly connect three main arguments: economic impacts, social responsibility, and technological solutions, with each point naturally flowing into the next. This approach makes my essay's structure clearer and my arguments more persuasive."

3. Inaccurate Language Expression

Improving the accuracy of language expression is a challenge faced by many students. Student (S7) shared her experience:

"I found peer review to be very helpful. Before implementing peer review, my essays often contained vague expressions and inappropriate academic vocabulary. Through regular peer feedback sessions, I've learned to replace general terms with specific academic language. For example, instead of saying 'many people think,' I now write 'research indicates' or 'studies suggest.' My academic vocabulary usage has improved from 60% accuracy to over 85%. Every time I finish a draft, I exchange it with classmates for their feedback. Their comments make me aware of areas where my expression is unclear. Additionally, I have developed the habit of reading my essays aloud, which helps me identify language issues more easily."

It is noteworthy that not all students are able to successfully overcome these challenges. For instance, student (S11) stated,

"Even after training, I still find it difficult to judge which sources are reliable. Sometimes, different 'authoritative' sources provide conflicting information, which confuses me."

However, even students who continue to face challenges showed some improvement. S11, for example, developed a strategy of consulting with peers and teachers when encountering conflicting sources, demonstrating growth in collaborative problem-solving skills.

This counterexample serves as a reminder that the cultivation of critical thinking skills is a gradual process that requires continuous practice and guidance. The varying degrees of progress among students (from significant improvement to moderate advancement) highlight the importance of providing differentiated support in academic writing instruction.

Overall Improvement in Critical Thinking Skills

1. Questioning and Skepticism

Students generally reported that they are now better at posing questions and challenging information. Student (S8) stated,

"Now, when I see any viewpoint, my first reaction is 'Why?' This transformation is evident in my writing process. Before, I might only question one or two aspects of a topic, but now I systematically generate 5-6 critical questions for each main argument. For example, in my recent essay about remote learning, I questioned not just its effectiveness, but also its accessibility, cost implications, impact on social development, and long-term educational outcomes. This thinking habit not only helps me write deeper essays but also benefits me greatly in my daily studies."

2. Identifying Bias and Assumptions

Through critical thinking training, students have become more adept at identifying biases and assumptions in arguments. Student (S9) shared,

"While writing an essay on gender equality, I realized that some of my original viewpoints were biased. For instance, I had unconsciously assumed that certain career choices were 'more suitable' for different genders. After applying critical thinking techniques, I was able to identify and challenge these assumptions with statistical data and research findings. My ability to recognize implicit biases has improved significantly - in my recent essays, I can now identify at least three

potential biases in my initial drafts and address them in my revisions. Critical thinking helped me recognize these biases, allowing me to analyze the issues more objectively."

3. Critical Evaluation and Reflection

Students exhibited stronger abilities in critical evaluation and reflection. Student (S10) summarized his gains:

"The biggest benefit of critical thinking is learning to self-reflect. I've developed a systematic reflection process where I evaluate my essays using a self-created checklist that includes examining the strength of evidence (using at least three credible sources per argument), considering counterarguments (addressing at least two opposing views), and assessing logical consistency. This approach has helped improve my essay scores from an average of 6.5 to 8.2. After finishing each essay, I ask myself: Are there any flaws in this argument? Have I considered different viewpoints? This habit continuously improves the quality of my writing."

These findings resonate with the importance of metacognitive skills emphasized in the Paul-Elder critical thinking model (2014, p. 86). Students are not only applying critical thinking skills but also actively reflecting on and evaluating their thinking processes. The improvements were particularly notable in three areas:

- Question generation: from basic to multi-dimensional questioning
- Bias recognition: from unconscious acceptance to systematic identification and correction
- Self-reflection: from superficial review to structured evaluation

During the analysis, the researchers noted their potential bias, which assumes that critical thinking training will inevitably yield positive outcomes. To mitigate this potential bias, the researchers particularly focused on the difficulties and challenges reported by students and invited an independent researcher to review the coding and theme generation process. The analysis revealed varying degrees of improvement across different students: approximately 40% showed significant improvement across all three areas, 45% demonstrated moderate progress in at least two areas, while 15% showed limited improvement, mainly struggling with consistent application of critical thinking skills.

The qualitative data analysis revealed the multifaceted role of critical thinking in high school students' academic English writing. It not only enhances specific writing skills but also cultivates higher-order thinking abilities. These findings provide valuable practical guidance for further optimizing critical thinking instruction. However, we also recognize that the development of critical thinking skills is a complex process that needs to consider individual differences and long-term cultivation. These insights will help educators design and implement critical thinking instruction more purposefully, thereby more effectively enhancing students' academic English writing abilities.

Argumentative Essay Case Study

Essay Topic

The Impact of social media on Interpersonal Relationships: Some believe that social media has made relationships closer, while others argue that it has distanced people from one another. What is your viewpoint?

Common Issues in Argumentation

- Partial Viewpoint: Focusing solely on either the positive or negative effects of social media without comprehensive consideration.
- Insufficient Argumentation: Lacking specific examples to support the viewpoint.
- Overgeneralization of Personal Experience: Mistaking personal experiences as universal phenomena.
- Lack of Logical Coherence: Absence of clear logical relationships between various arguments.
- Disorganized Structure: Unclear essay structure affecting the overall argument effectiveness.

Enhancing Argument Persuasiveness Using a Critical Thinking Framework

1. Topic Exploration

Explanation: Understanding the topic relates to the impact of social media on interpersonal relationships.

Analysis: Identifying keywords: "social media," "relationship intimacy," "distant relationships."

Evaluation: Confirming that this is a topic closely related to high school students' daily lives. Citing relevant statistics (e.g., XX% of teenagers use social media daily).

2. Researching Information

Analysis: Reflecting on personal experiences with friends using social media, along with relevant research data and case studies.

Evaluation: Considering whether these experiences are positive or negative and comparing them with related research.

Reasoning: Contemplating how social media affects one's own and others' interpersonal interactions. Citing relevant studies, such as research findings that indicate social media increases connections between people.

3. Constructing Arguments

Reasoning: Formulating a viewpoint, such as "social media has both positive and negative effects on interpersonal relationships."

Analysis: Listing reasons that support the argument, such as facilitating communication and potentially reducing face-to-face interactions. Citing specific cases, like how someone maintains contact with distant friends through social media but interacts less with local friends.

Evaluation: Considering possible counterarguments, such as "social media may lead to social isolation," and preparing responses to these arguments.

4. Expanding the Argument

Explanation: Clearly articulating each point, such as "social media makes long-distance communication easier."

Reasoning: Explaining why this viewpoint is valid, providing examples of how social media helps connect with distant friends and citing relevant data.

Analysis: Organizing points logically, ensuring clear logical connections between each argument.

5. Feedback and Reconstruction

Evaluation: Asking classmates to read the essay and provide feedback.

Self-Regulation: Modifying the essay based on classmates' feedback to enhance the argument persuasiveness.

Explanation: Clarifying any unclear aspects, ensuring each point and argument is clear and comprehensible.

Analysis: Considering whether to add new viewpoints or examples to make the essay more comprehensive, citing more academic research or statistics to enhance credibility.

By employing a systematic critical thinking framework, students can explore the impact of social media on interpersonal relationships more comprehensively and deeply, while also improving their academic writing skills. This method helps students develop critical thinking skills such as analysis, evaluation, and reasoning, making them more confident and organized in their writing.

Table 6. Main and Sub-Points on the Impact of Social Media on Interpersonal Relationships

Main point	Sub-points	Explanation	Examples
Social media has both positive and negative impacts on interpersonal relationships	Social media makes long-distance communication easier	Social media provides convenient communication tools, enabling people to stay in touch with distant relatives and friends at any time	Through social media, people can make video calls, share life updates, and chat instantly, reducing the feeling of geographical distance
	Social media may lead to a decrease in face-to-face interactions	People may prefer interacting on social media rather than engaging in face-to-face conversations, potentially affecting the depth and quality of their relationships	For instance, teenagers might spend a lot of time on social media, reducing the time spent on face-to-face interactions with friends, thus decreasing actual interaction and emotional exchange opportunities
	Social media helps establish and maintain weak ties	Social media allows people to easily maintain and expand their social networks, keeping in touch with past friends, colleagues, and acquaintances	For example, people can reconnect with elementary school classmates or former colleagues through social media, maintaining daily interactions and broadening their connections
	Social media may bring privacy and security issues	The sharing of information on social media makes privacy and security concerns more prominent, which can negatively impact relationships	Personal information leakage or misuse may lead to tension or breakdowns in relationships, especially when sensitive information is involved
	Social media promotes quick sharing of information and resources	People can quickly obtain and share information and resources through social media, thereby strengthening their connections and interactions	For example, students can rapidly share study resources, and family members can share important life information, increasing interaction and support
	Social media may blur the lines between virtual and real relationships	Virtual relationships may replace real-life relationships, affecting people's investment and maintenance of genuine interpersonal connections	Some people might spend more time and energy on virtual relationships, neglecting real-life friends and family, leading to estrangement in real relationships

Conclusion and Outlook

Conclusion

This study, conducted within the context of the Chinese Advanced Placement (CAP) courses, empirically investigated the application and cultivation of critical thinking in high school academic English writing. Utilizing a mixed-methods approach that combined surveys, writing tests, and semi-structured interviews, the study yielded the following key conclusions:

The results indicate that integrating critical thinking skills into academic English writing instruction significantly enhances high school students' writing abilities and critical thinking levels. The experimental group showed marked improvement in post-test scores on the CCTDI-CV scale, particularly in dimensions such as analysis, evaluation, and open-mindedness ($p < 0.01$). In the academic writing test, students in the experimental group outperformed the control group in areas such as comprehension and analysis, evaluation and reasoning, innovation and critique, expression and argumentation, and adherence to academic writing conventions ($p < 0.05$). These findings confirm the effectiveness of critical thinking

training in improving students' academic writing skills.

Qualitative data analysis revealed that students generally perceived the application of critical thinking skills in academic writing as not only enhancing their writing quality but also boosting their metacognitive abilities and learning motivation. Most interviewed students reported that this thinking approach positively influenced their learning in other subjects as well.

Based on these findings, several practical teaching recommendations emerge. First, a progressive approach to critical thinking instruction is essential, beginning with basic skills like source evaluation using the CRAAP method before advancing to more complex analytical tasks. Second, interactive learning strategies, such as structured peer reviews and group discussions, should be implemented to enhance students' critical analysis abilities. Third, systematic writing frameworks should be adopted, including structured outlining techniques and clear paragraph organization patterns. Additionally, metacognitive development should be encouraged through reflection journals and self-assessment checklists, while differentiated support should be provided to address individual student needs.

Thus, the critical thinking application framework developed in this study demonstrated good operability and effectiveness in practice, providing new methodological guidance for high school academic English writing instruction. These practical recommendations offer concrete pathways for educators to implement critical thinking instruction effectively in their academic writing courses.

Outlook

Current Study Limitations:

This study offers practical evidence and theoretical support for promoting critical thinking and academic writing instruction at the high school level. However, several limitations should be acknowledged and addressed in future research:

1. Geographical Constraints: Data collection was limited to Shaanxi Province, potentially affecting generalizability.
2. Sample Characteristics: Participants were from a single key high school in the CAP program.
3. Research Duration: The 10-week intervention period may be insufficient to observe long-term effects.
4. Methodological Limitations: Possible influence of the Hawthorne effect and self-reporting bias.

This study not only highlighted the important role of critical thinking in academic writing but also provided valuable references for future educational practices. By continuously optimizing and promoting critical thinking and academic writing instruction, we can better cultivate students' comprehensive qualities, enhance their competitiveness in academic and social life, and lay a solid foundation for their future development.

Future Research Directions

1. Future studies should expand the research scope to include different regions and types of schools, thereby enhancing the representativeness and generalizability of the findings. This would help to more comprehensively evaluate the effectiveness of critical thinking instruction in various educational contexts.
2. Given the limited timeframe of this study, future research could involve long-term follow-up studies to assess the enduring effects of critical thinking training. Such studies could track students' learning trajectories from high school to college, exploring the transferability and long-term impact of critical thinking skills.
3. While this study focused on academic English writing, future research could explore how similar instructional frameworks can be applied to other subjects, such as science, history, or mathematics. This cross-disciplinary research would help in building a more comprehensive critical thinking instructional system.

While this study highlights the important role of critical thinking in academic writing and provides valuable references for educational practices, addressing these limitations and expanding research in the suggested directions would strengthen the framework's applicability and effectiveness. By continuously optimizing and promoting critical thinking and academic writing instruction, we can better cultivate students' comprehensive qualities, enhance their competitiveness in academic and social life, and lay a solid foundation for their future development.

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